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24998	7590	04/22/2004	EXAMINER	
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2101 L STREET NW			ART UNIT	
WASHINGTON, DC 20037-1526			PAPER NUMBER	

2815

DATE MAILED: 04/22/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

# Office Action Summary

Application No.

10/075,390

Applicant(s)

CAMPBELL ET AL.

Examiner

N. Drew Richards

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

## Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

## Status

- 1) ☒ Responsive to communication(s) filed on 09 January 2004.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

## Disposition of Claims

- 4) ☒ Claim(s) 1-59 is/are pending in the application.
- 4a) Of the above claim(s) 34-59 is/are withdrawn from consideration.
- 5) ☒ Claim(s) 11, 12 and 15-19 is/are allowed.
- 6) ☒ Claim(s) 1-5, 7-10, 13, 14, 20, 21, 23-27, 31 and 32 is/are rejected.
- 7) ☒ Claim(s) 6, 22, 28-30 and 33 is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

## Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 15 February 2002 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

## Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

## Attachment(s)

- |                                                                                                                                                     |                                                                                         |
|-----------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)                                                                         | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)                                                                | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)             |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date <u>4/3/02, 10/23/02</u> | 6) <input type="checkbox"/> Other: _____                                                |

## **DETAILED ACTION**

### ***Election/Restrictions***

1. Applicant's election without traverse of claims 1-33 in Paper received 1/9/04 is acknowledged.

### ***Drawings***

2. The drawings are objected to as failing to comply with 37 CFR 1.84(p)(4) because reference character "140" has been used to designate both a process segment in figure 1 and a memory element in figure 3. A proposed drawing correction or corrected drawings are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.
3. The drawings are objected to as failing to comply with 37 CFR 1.84(p)(5) because they do not include the following reference sign(s) mentioned in the description: reference numeral 66 as mentioned in paragraph 41 and reference numbers 91 and 93 as mentioned in paragraph 44. A proposed drawing correction or corrected drawings are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.
4. The drawings are objected to as failing to comply with 37 CFR 1.84(p)(5) because they include the following reference sign(s) not mentioned in the description: reference numerals 20,22,24,26,28 and 30 as shown in figure 3. A proposed drawing

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correction, corrected drawings, or amendment to the specification to add the reference sign(s) in the description, are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

### ***Specification***

5. The disclosure is objected to because of the following informalities: The specification lacks a detailed description of figure 3.

Appropriate correction is required.

### ***Claim Rejections - 35 USC § 112***

6. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

7. Claims 13 and 14 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claims 13 and 14 refer to a heating step which is not claimed in claim 11 from which claims 13 and 14 depend. It is indefinite as to whether the heating in claims 13 and 14 is a further step in the process claimed in claim 11 or whether claims 13 and 14 are further limiting a nonexistent heating step in claim 11. If claims 13 and 14 are adding a further process step it is indefinite as to when the heating step occurs in relation to the previously claimed process of claim 11.

8. Claim 4 recites the limitation "said glass material" in line 2. There is insufficient antecedent basis for this limitation in the claim.

***Claim Rejections - 35 USC § 102***

9. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

10. Claims 1-5 are rejected under 35 U.S.C. 102(b) as being anticipated by Sandhu et al. (U.S. Patent No. 5,837,564).

With regard to claim 1, Sandhu et al. disclose a method of fabricating a resistance variable memory element comprising:

forming a layer of resistance variable material (chalcogenide material deposited, see column 2 lines 56-57); and

subsequently increasing the rigidity of the resistance variable material (after deposition the chalcogenide material is annealed, see column 2 lines 58-59).

Sandhu et al. do not explicitly disclose their annealing step "increasing the rigidity" or the resistance variable material. However, Sandhu et al. disclose a similar material as in the instant application (chalcogenide glass disclosed as selected from the group of Te, Se, Sb, and Ge, see column 1 lines 44-46) and disclose performing an similar anneal as in the instant application (the anneal is taught as being at about 250

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degrees C for about 10 minutes, see column 5 lines 55-63). Thus it is considered inherent that the annealing process of Sandhu et al. will result in an increase in the rigidity of the variable resistance material.

With regard to claim 2, the step of increasing the rigidity comprises annealing the resistance variable memory element (annealed as taught on column 5 lines 55-63).

With regard to claim 3, though not explicitly disclosed, it is nonetheless inherently understood that the annealing step comprises heating the resistance variable material to a temperature of about or below the thin-film glass transition temperature of the resistance variable material. This step is inherently taught as the temperature taught for the annealing is about or below the thin-film glass transition temperature of the resistance variable material.

With regard to claim 4, the annealing is disclosed as comprising heating to a temperature in the range from about 200 to about 330 degrees C for a time from about 5 to about 15 minutes (see column 5 lines 55-63).

With regard to claim 5, the time period is about 10 minutes.

### ***Claim Rejections - 35 USC § 103***

11. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

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12. Claims 7-10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sandhu et al. as applied to claims 1-5 above, and further in view of Applicant's admitted prior art (hereafter referred to as "APA").

With regards to claims 7-10, Sandhu et al. do not explicitly disclose the resistance variable comprising a germanium-selenide glass or having a mean coordination number of at least about 2.46.

APA teach in paragraphs 4-9 a preferred resistance variable material comprising a germanium-selenide glass comprising silver.

With regard to claim 7, APA teach a germanium-selenide being a preferred variable resistance material (paragraph 6, first line)

With regard to claims 8 and 9, APA teach the germanium-selenide glass having a stoichiometry between about  $\text{Ge}_{20}\text{Se}_{80}$  and  $\text{Ge}_{23}\text{Se}_{77}$  which has a germanium molar concentration number of equal to or less than about 0.23 (paragraph 9).

Sandhu et al. and APA are combinable because they are from the same field of endeavor. At the time of the invention it would have been obvious to a person of ordinary skill in the art to use the preferred germanium-selenide glass with the claimed composition as the variable resistance material. The motivation for doing so is to allow silver to be directly incorporated into the layer such that the silver can form dendrites and result in nonvolatile change between high and low resistance states, thus allowing for use in a memory cell. Therefore, it would have been obvious to combine Sandhu et al. and APA to obtain the invention of claims 7-9.

With regard to claim 10, in combining the material of APA into the annealing process of Sandhu et al., the variable resistance material would inherently have a mean coordination number of at least about 2.46. The material and annealing process are similar to that of the instant invention and thus the resulting mean coordination number would inherently be the same.

13. Claims 20, 21, 23-25 and 27 are rejected under 35 U.S.C. 103(a) as being unpatentable over WO 00/48196 A1 in view of Sandhu et al. (U.S. Patent No. 5,837,564).

WO 00/48916 A1 (here after "196") teaches a method of forming a resistance variable memory element comprising:

forming a first electrode 130 (figure 1, page 8 line 23);

forming an insulating layer 150 over the first electrode 130 (figure 1, page 8 line 25);

etching an opening in the insulating layer 150 to expose the first electrode 130 (figure 1, page 8 lines 25-27);

depositing a resistance variable material 140 in the opening (figure 1, page 8 lines 27-28);

adding a metal to the resistance variable material 140 to form a metal containing resistance variable material (page 7 lines 12-15); and



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forming a second metal electrode 120 in contact with the metal containing resistance variable material (figure 1, page 8 lines 27-28; the second electrode 120 is taught as being metal on page 6 lines 3-10).

'196 does not teach increasing the rigidity of the metal containing resistance variable material.

Sandhu et al. teach a method of forming a resistance variable memory element including depositing a layer of resistance variable material (chalcogenide material deposited, see column 2 lines 56-57); and

subsequently increasing the rigidity of the resistance variable material (after deposition the chalcogenide material is annealed, see column 2 lines 58-59).

Sandhu et al. do not explicitly disclose their annealing step "increasing the rigidity" or the resistance variable material. However, Sandhu et al. disclose a similar material as in the instant application (chalcogenide glass disclosed as selected from the group of Te, Se, Sb, and Ge, see column 1 lines 44-46) and disclose performing an similar anneal as in the instant application (the anneal is taught as being at about 250 degrees C for about 10 minutes, see column 5 lines 55-63). Thus it is considered inherent that the annealing process of Sandhu et al. will result in an increase in the rigidity of the variable resistance material.

'196 and Sandhu et al. are combinable because they are from the same field of endeavor. At the time of the invention it would have been obvious to a person of ordinary skill in the art to perform the annealing process of Sandhu et al. which results in increasing the rigidity of the layer in the process of '196. The motivation for doing so

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is to transform the resistance variable material to a crystalline form by an optimal process to obtain high electrical performance (see Sandhu et al. abstract and title). Therefore, it would have been obvious to combine '196 with Sandhu et al. to obtain the invention of claim 20.

With regard to claim 21, Sandhu et al. teaches the step of increasing the rigidity comprises annealing the resistance variable memory element (annealed as taught on column 5 lines 55-63).

With regard to claim 23, though not explicitly taught by Sandhu et al., it is nonetheless inherently understood that the annealing step comprises heating the resistance variable material to a temperature of about or below the thin-film glass transition temperature of the resistance variable material. This step is inherently taught as the temperature taught for the annealing is about or below the thin-film glass transition temperature of the resistance variable material.

With regard to claim 24, Sandhu et al. teaches the annealing is disclosed as comprising heating to a temperature in the range from about 200 to about 330 degrees C for a time from about 5 to about 15 minutes (see column 5 lines 55-63).

With regard to claim 25, Sandhu et al. teaches the time period is about 10 minutes.

With regard to claim 27, '196 teaches the resistance variable material comprising a germanium-selenide composition (page 7 lines 4-7).

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14. Claims 26, 31 and 32 are rejected under 35 U.S.C. 103(a) as being unpatentable over WO 00/48196 A1 in view of Sandhu et al. (U.S. Patent No. 5,837,564) as applied to claims 20, 21, 23-25 and 27 above, and further in view of APA.

With regards to claims 31 and 32, '196 with Sandhu et al. does not explicitly disclose the resistance variable comprising a germanium-selenide glass wherein the glass layer has a stoichiometry between about  $\text{Ge}_{20}\text{Se}_{80}$  and  $\text{Ge}_{23}\text{Se}_{77}$  which has a germanium molar concentration number of equal to or less than about 0.23.

APA teach in paragraphs 4-9 a preferred resistance variable material comprising a germanium-selenide glass comprising silver. APA also teach a germanium-selenide being a preferred variable resistance material (paragraph 6, first line)

With regard to claims 31 and 32, APA teach the germanium-selenide glass having a stoichiometry between about  $\text{Ge}_{20}\text{Se}_{80}$  and  $\text{Ge}_{23}\text{Se}_{77}$  which has a germanium molar concentration number of equal to or less than about 0.23 (paragraph 9).

'196 with Sandhu et al. and APA are combinable because they are from the same field of endeavor. At the time of the invention it would have been obvious to a person of ordinary skill in the art to use the preferred germanium-selenide glass with the claimed composition as the variable resistance material. The motivation for doing so is to allow silver to be directly incorporated into the layer such that the silver can form dendrites and result in nonvolatile change between high and low resistance states, thus allowing for use in a memory cell. Therefore, it would have been obvious to combine '196 with Sandhu et al. and APA to obtain the invention of claims 31 and 32.

With regard to claim 26, in combining the material of APA into the process of '196 with Sandhu et al., the variable resistance material would inherently have a mean coordination number of at least about 2.46. The material and annealing process are similar to that of the instant invention and thus the resulting mean coordination number would inherently be the same.

***Allowable Subject Matter***

15. Claims 11, 12, and 15-19 are allowed.

16. Claims 6, 22, 28-30 and 33 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

17. The following is a statement of reasons for the indication of allowable subject matter: Prior art of record fails to teach, disclose, or suggest, either alone or in combination, a method comprising either annealing the variable resistance material in an atmosphere comprising oxygen, or removing some selenium from the resistance variable material, or changing the stoichiometry of the variable resistance material.

***Conclusion***

18. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Kozicki (US Pub. 2003/0107105 A1), Bagley (U.S. Patent No.


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4920078), Pryor et al. (U.S. Patent No. 4804490), Klersy et al. (U.S. Patent No. 5933365), Klersy et al. (U.S. Patent No. 5330630), Moore (US Pub. 2003/0096497 A1).

Any inquiry concerning this communication or earlier communications from the examiner should be directed to N. Drew Richards whose telephone number is (571) 272-1736. The examiner can normally be reached on M-F 8:00-5:30; Every other Friday off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tom Thomas can be reached on (571) 272-1664. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



NDR